

Stoneflies (Plecoptera) In Gray's Run In Northeastern Ohio¹

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ABSTRACT. A survey of stoneflies was conducted at Gray's Run (Mahoning County, Ohio), a small (2.9 km), high gradient stream occurring in the glaciated Appalachian Plateau. A total of 1,779 stoneflies were collected in 1984–1985 by hand net and hand-picking from rocks, vegetation, and leaf packs. Among these were 18 species, 12 genera, and six families. The stonefly community in Gray's Run appears to have been strongly influenced by stream ecology and proximity to Appalachian source streams. *Malirekus hastatus* (Banks), *Peltoperla arcuata* Needham, and *Sweltsa lateralis* Banks, three Appalachian species, are reported in Ohio for the first time. Over 50% of the species occurring in Gray's Run are either of Appalachian origin and/or prefer small, cool streams characteristic of that region. The flight periods of the three most common families, Chloroperlidae, Leuctridae, and Nemouridae, are outlined. Afternoon emergence and predation of Chloroperlidae by Empididae were observed.

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INTRODUCTION

The generally low relief of the glaciated section of the Appalachian Plateau, a result of the retreat of the most recent ice sheet, the Wisconsin, has influenced the character of streams in that region. Most are contained in relatively shallow, broad stream beds and are not strongly dissected. Gray's Run is located in Poland Township, Mahoning County, Ohio and lies in the broad ground moraine of the southern portion of the glaciated section of the plateau. Physically, it is similar to streams in the unglaciated part of the Appalachian Plateau of southeastern Ohio and resembles mountainous West Virginia and Pennsylvania streams. MacLean (1983) reported a caddisfly, *Ceratopsyche ventura* (Ross), from Gray's Run, which is usually restricted to Appalachian mountain streams.

The most comprehensive stonefly collections have been made almost exclusively in southern and south-central Ohio (Walker 1947, Gaufin 1956). Other records (Needham and Claassen 1925, Claassen 1931, 1939, Frison 1937, 1942, and Ricker 1952) also include this general area. Two recent studies in Geauga (Tkac and Foote 1978) and Lake (Robertson 1979) counties in northeastern Ohio have added new state records.

The purpose of the present study was to explore the possibility that Gray's Run, similar to Appalachian streams in West Virginia and Pennsylvania but occurring in an area of low relief, might support a similar stonefly fauna. A secondary purpose was to determine relative abundances and flight periods of the Plecoptera there.

SITE DESCRIPTION

Gray's Run lies north of the downtown area of Lowellville, Ohio (Fig. 1). It is a second-order stream that has resulted from the coalescence of two first-order streams (Hynes 1970). It is 2.9 km in length and drains an area of 5.4 km² (Gazetteer of Ohio Streams 1954). The average fall is 31 m per km. It drains into the Mahoning River about 0.5 km west of the Gauging Station on the river.

The streambed of Gray's Run has been cut through layers of Pennsylvanian conglomerates, shale, coal, and

sandstone of the Pottsville Formation (Rau 1970, White 1960). There are extensive expanses of dissected shale, alternating with cobbles, gravel and sand that make up the substratum and extend into the two, steep gradient, first-order branches. The northwest branch courses through slate bedrock, whereas the northeast branch is choked with very large boulders that slow water flow and create a shallow, gravelly stream similar to many Appalachian streams.

Along the entire stream, the banks rise 20 m or more overhead. The unstable nature of the largely sedimentary banks is evident throughout the system. At several points, very large boulders have broken loose from the walls and fallen into the stream, causing deep pools to

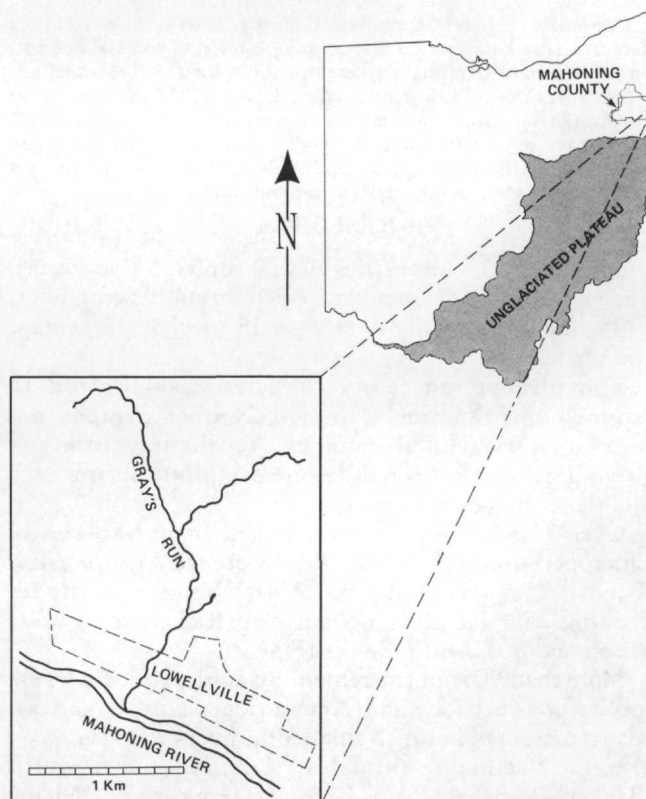


FIGURE 1. Location map of Gray's Run, Mahoning County, Ohio.

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collect at their sides. Some of these pools are 1 to 2 m deep, even during droughts.

The water level in Gray's Run is subject to extreme variation that is dependent upon seasonal rain and spring runoff. It becomes a shallow, intermittent stream during dry periods. Grooves worn in the shale substrate by trickles of water indicate periods of low water levels. Stream width does not exceed 7 m; the depth varies from 5 to 200 cm.

The silt load in the stream is very light, except during flood stage. During the remainder of the year, the substrate is clearly visible throughout the length of the stream. Rocks on the bottom do not accumulate silt nor support the heavy periphyton layer found in streams of lower gradients.

A mixed mesophytic woods (Braun 1950) is present on the slopes of the stream and extends up to the stream bank. White elms (*Ulmus americana*) and witch hazel (*Hamamelis virginiana*) are particularly numerous along the edge of the stream. Hemlocks (*Tsuga canadensis*) growing mainly along the east and west ridges above the stream are responsible for the local name of "Pine Hollow." Rooted, aquatic vegetation in the stream is nonexistent.

In spite of well developed, overhanging, mesophytic woods, the amount of allochthonous material present in the main stream is small because of the lack of numerous large rocks that would otherwise retard flow and allow the accumulation of leaf packs. On the other hand, leaf packs in the two branches are more common, probably due to their boulder-strewn nature.

MATERIALS AND METHODS

Monthly collections of stonefly nymphs were made by hand, generally for one hour, during the months of October, 1984 through April, 1985. All nymphs were taken by hand-picking from stream rocks and leaf packs.

During May through September, 1985, weekly collections of adults were made by hand net on stream-side vegetation for 1-h periods. Some black-light trapping was attempted but yielded few stoneflies.

Specimens were placed in 80% ethanol, sorted, and examined with a dissecting microscope. Identifications were done with standard taxonomic keys (e.g. Hitchcock 1974, Claassen 1931, Needham and Claassen 1925, Frison 1942, Ricker 1952). Collection week numbers in Figures 2-4 are according to Lewis and Taylor (1967).

RESULTS

A total of 1,779 stoneflies (1,239 adults, 540 nymphs) was collected from October, 1984 through September, 1985. Included in this total were 18 species, 12 genera, and six families.

The plecopteran fauna collected was limited to "spring" and "summer" species. Neither nymphs nor adults of the "winter" families, Taeniopterygidae and Capniidae, were collected despite sampling during each month of the year.

Over 75% of the adults belonged to five species of Chloroperlidae. Of these, 50% were *Haploperla brevis* (Banks), 25% were *Alloperla chloris* Frison, and the remaining 25% included *Sweltsa onkos* Ricker, *A. caudata* Frison and *S. lateralis* Banks (Fig. 2).

More than 90% of the remaining adults collected were species of Leuctridae and Nemouridae (Figs. 3 and 4). Also represented in much smaller numbers were *Peltoperla arcuata* Needham, 6 males; *Acroneuria carolinensis* (Banks), 2 males; *Perlesta placida* (Hagen), 1 female; *Diploperla robusta* (Stark and Gauvin), 2 females, 2 males;

Malirekus hastatus (Banks), 1 male; and *Isoperla nana* (Walsh), 1 female, 1 male. Two species were collected only as nymphs, *Soyedina vallicularia* (Wu) and *Isoperla namata* Frison.

It was possible to distinguish flight patterns for the Chloroperlidae, Leuctridae, and Nemouridae. Adult Nemouridae appeared in collections from mid-May through mid-July (Fig. 4). Chloroperlid adults were collected from mid-May through mid-August (Fig. 2). The longest duration (early May-early September) was found among the Leuctridae (Fig. 3).

During the month of May, 1985, two unusual events were recorded. Chloroperlids were observed emerging from 1200 into the afternoon, and swarms of the dipteran family, Empididae, were seen hovering over riffles and capturing these newly emergent chloroperlid adults.

DISCUSSION

The ecology and physical features of Gray's Run have apparently played a crucial role in providing the opportunity for the development of a stonefly community characteristic of Appalachian streams in southwestern Pennsylvania and western West Virginia. These streams, like Gray's Run, have steep gradients that result in clear, cool water with considerable current and numerous riffles. As indicated before, Gray's Run has a stream-fall of 31 m per km. In contrast, the average stream-fall for 60 other streams in the Mahoning River Basin, Mahoning County, is 6.7 m per km. These milder gradients produce streams that generally carry greater volumes of water, with less seasonal variability in volume and only occasional riffle areas.

Perhaps geography has also been important since Gray's Run lies at the extreme eastern edge of Ohio, about 1 km from the Pennsylvania line. This places it in a favorable position relatively close to Appalachian source regions in Pennsylvania and West Virginia. The distance from the boundary of Hancock County in the northern panhandle of West Virginia is approximately 45 km.

Two other streams in the glaciated Allegheny Plateau, one at Stebbins Gulch in Geauga County and the other at Penitentiary Glen in Lake County, apparently possess some physical and ecological characteristics similar to Gray's Run (Tkac and Foote 1978, Robertson 1979). However, they are farther from Appalachian source areas. The Pennsylvania border lies approximately 60 km east of these two sites; West Virginia is about 135 km southeast.

A comparison of the faunas of the three streams revealed that a number of stoneflies are common to each; others are found at two of the three. Some are peculiar, however, to a single stream (Table 1). There is an Appalachian element that is found only at Gray's Run. At least three stoneflies (*Malirekus hastatus*, *Peltoperla arcuata* and *Sweltsa lateralis*) occurring in Gray's Run are considered Appalachian species (Baumann 1979, Ricker 1952, Ricker et al. 1968). Surdick (1985) referred to *S. lateralis* as an eastern stonefly that reinvaded the northern Appalachians following Pleistocene glaciation. All of these were recorded for the first time in Gray's Run in Ohio. A fourth species, *Diploperla robusta*, has a central and southeastern distribution (IN, KY, OH, VA and WV); however, the genus *Diploperla* was considered to be Appalachian by Illies (1965). It has previously been recorded

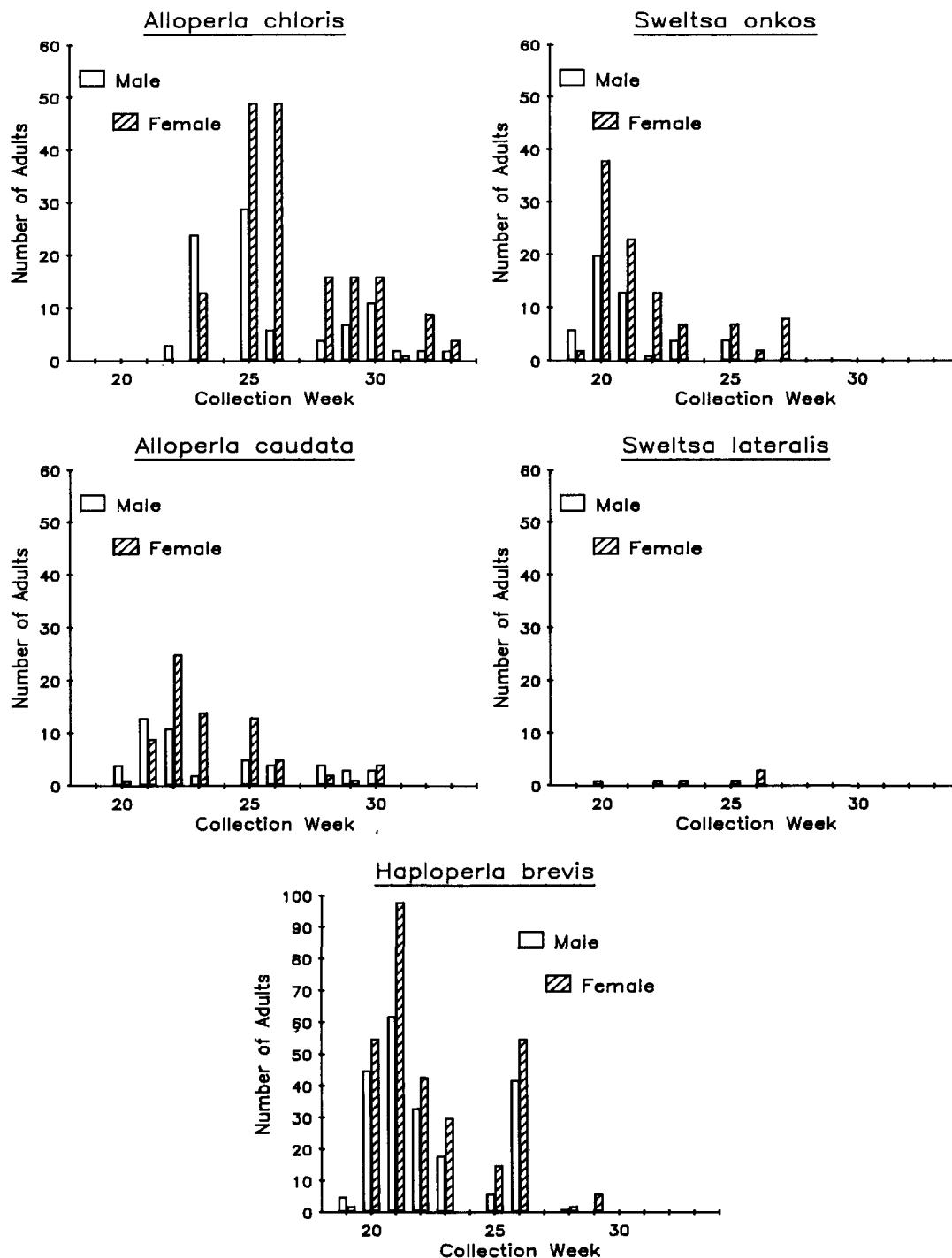


FIGURE 2. Flight pattern of Chloroperlidae, showing relative abundances of males and females.

in Athens, Hocking and Tuscarawas counties in Ohio (Stark and Gaufin 1974). Most of Hocking and all of Athens and Tuscarawas counties lie in the unglaciated Allegheny Plateau.

One-half ($N = 9$) of the stonefly species in Gray's Run are characteristic of cool streams. Four species of Chloroperlidae, *A. caudata*, *A. chloris*, *S. lateralis* and *S. onkos*, prefer this habitat (Baumann 1979, Surdick 1985). *Haploperla brevis* is more tolerant of warmer, slower streams and is more widely distributed (Baumann 1979, Surdick 1985). Others preferring stenothermal conditions are *Leuctra ferruginea* (Walker), *L. sibleyi* Claassen, *P. arcuata*,

and *S. vallicularia* (Baumann 1979, Harper 1973, Harper and Hynes 1971a and Ricker 1965). Claassen (1931) characterized the habitat of *M. hastatus* as cold, well-oxygenated, "upland spring brooks" which is a good description of the northeast, first-order stream where this species was collected.

In addition to favorable physical stream conditions, the presence of *Peltoperla* and *Soyedina* may have been influenced by the availability of leaves from preferred tree species. Wallace et al. (1970) studied the food choices of the nymphs of what was presumed to be *Tallaperla maria* (Stark and Stewart). They found that the nymphs chose

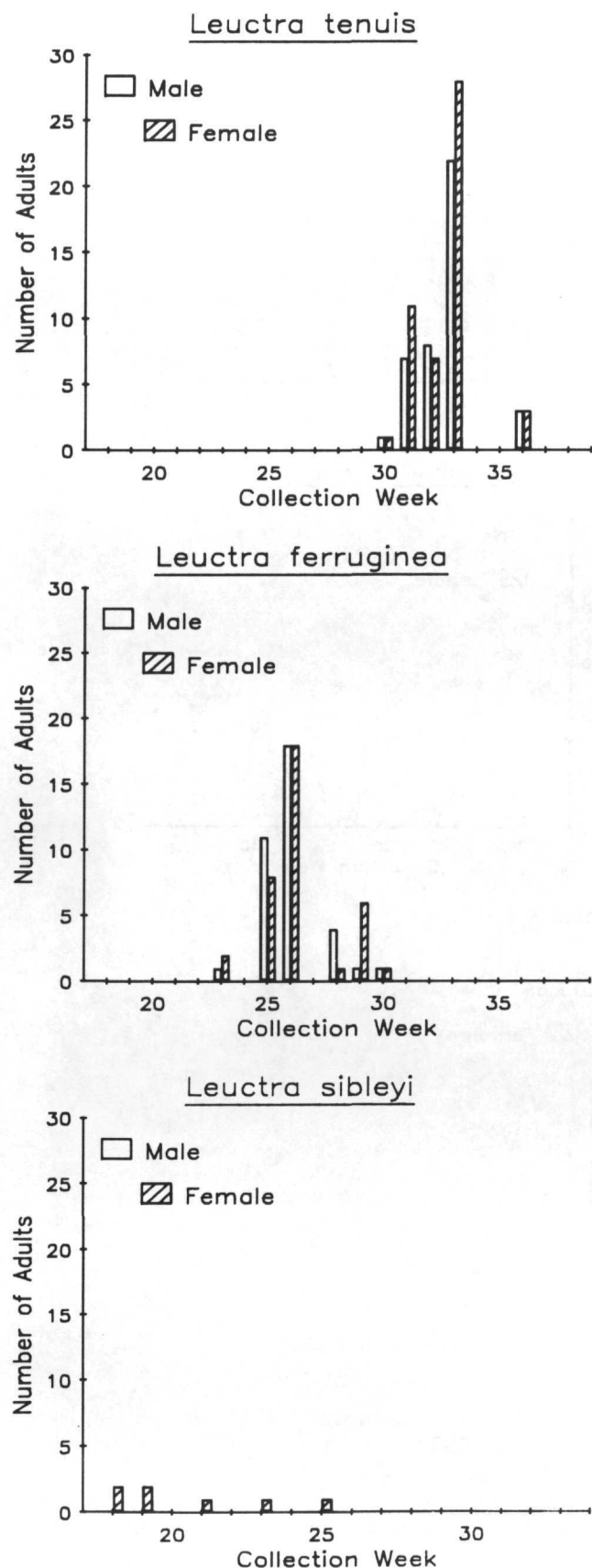


FIGURE 3. Flight pattern of Leuctridae, showing relative abundances of males and females.

elm (*Ulmus*) and dogwood (*Cornus*) leaves among a list of preferred tree species. Hitchcock (1974) stated that it was likely that most, if not all eastern peltoperlids, would

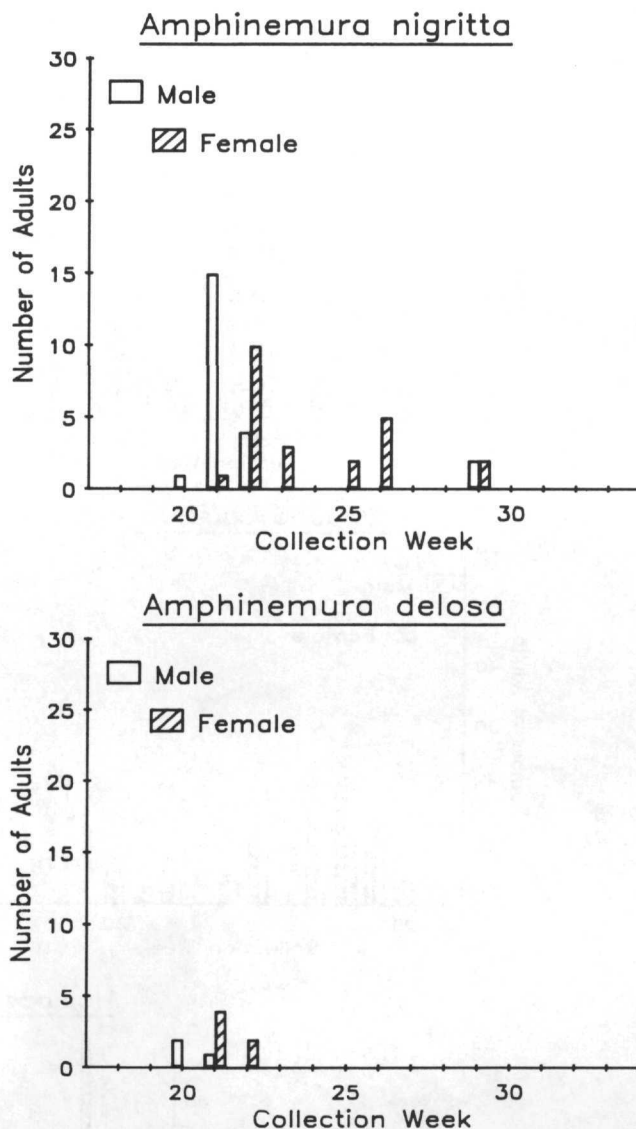


FIGURE 4. Flight pattern of Nemouridae, showing relative abundances of males and females.

show the same preferences. Wu (1923) observed that *S. vallicularia* ate elm leaves exclusively. Elm leaves are common in leaf packs at Gray's Run.

Another unique aspect of the stonefly community in Gray's Run is its lack of "winter" stoneflies. In contrast to Stebbins Gulch, where almost 40% of the fauna were "winter" stoneflies, no species of Capniidae or Taeniopterygidae were collected from Gray's Run. Their absence may be due to a variety of reasons. It is likely that the following are important, however. Most members of both families generally inhabit relatively warm water (Baumann 1979, Harper and Hynes 1972), where the permanent volume is fairly great (Frison 1929, Harper and Hynes 1971b, 1972). No part of Gray's Run fits this description. It is best described as a small, high gradient, shallow, stenothermal stream. Probably related to the lack of extensive stretches of deep water with slow currents is the lack of development of substantial numbers of leaf packs with which both families are so often associated in larger streams (Frison 1929, D. W. Fishbeck, personal observation). *Allocapnia* has been observed to prefer substrates with leaf packs (Reice 1980). In Gray's

TABLE 1
Plecopteran Communities Present in Gray's Run (GR), Stebbins
Gulch (SG)*, and Penitentiary Glen (PG)**

Family and Species	Site		
	GR	SG	PG
Peltoperlidae			
<i>Peltoperla arcuata</i>	X		
Leuctridae			
<i>Leuctra ferruginea</i>		X	
<i>L. sibleyi</i>	X	X	
<i>L. tenuis</i>	X	X	X
<i>Paraleuctra sara</i>		X	
Nemouridae			
<i>Amphinemura delosa</i>	X	X	X
<i>A. nigritta</i>	X	X	
<i>Ostrocerca truncata</i>		X	
<i>Prostoia similis</i>		X	
<i>Soyedina vallicularia</i>	X	X	X
Perlidae			
<i>Acroneuria abnormis</i>			X
<i>A. carolinensis</i>	X	X	X
<i>A. lycorias</i>		X	X
<i>Perlesta placida</i>	X	X	
<i>Phasgonophora capitata</i>		X	
Perlodidae			
<i>Cultus decus</i>			X
<i>Diploperla robusta</i>	X		
<i>Isoptera clio</i>		X	
<i>I. namata</i>	X	X	X
<i>I. nana</i>	X		
<i>Malirekus hastatus</i>	X		
Chloroperlidae			
<i>Alloperla caudata</i>	X	X	
<i>A. chloris</i>	X	X	X
<i>A. imbecilla</i>		X	
<i>Haploperla brevis</i>	X	X	
<i>Sweltsa lateralis</i>	X		
<i>S. mediana</i>		X	
<i>S. onkos</i>	X		
Capniidae			
<i>Allocaonia frisoni</i>		X	
<i>A. granulata</i>		X	
<i>A. illinoensis</i>		X	
<i>A. nivicola</i>		X	
<i>A. recta</i>		X	
<i>A. rickerti</i>		X	
<i>A. vivipara</i>		X	
<i>Paracapnia angulata</i>		X	
Taeniopterygidae			
<i>Taeniopteryx mauva</i>		X	
<i>T. meteui</i>		X	

*Tkac and Foote 1978

**Robertson 1979

Run the lack of numerous, large leaf packs is not due to an inadequate leaf supply, but rather their integrity is destroyed during periods of excessive rainfall. The turbulence of the main stream largely eliminates most packs. Despite the occurrence of more numerous leaf packs in the first-order streams, they are even shallower. The combination of shallow, cool water with an inadequate supply of leaf packs probably prevents colonization by "winter" stoneflies in Gray's Run.

Although this study was not designed to critically analyze population numbers, some general observations are possible. There may be several reasons for the appearance of high numbers of certain families (e.g. Chloroperlidae, Leuctridae, and Nemouridae) in the collections.

One possibility is post-emergent behavior. Surdick (1985) considered chloroperlids to be weak fliers that usually occupy sites on streamside vegetation. Harper (1973) reported that nemourids and leuctrids also tend to fly into shrubs and trees along streams shortly after leaving the water. The high walls of the deeply dissected streambed in Gray's Run have been instrumental in shaping the woods present. The overhanging canopy of vegetation and the understory of elms, witch hazel, ash (*Fraxinus*), and the like that grow at the edge of the water offer immediate refuge to members of the three families. Since collecting techniques were limited to hand-netting owing to heavy local recreational use of the area, species ratios may have been biased in favor of those stoneflies. On the other hand, abundant stretches of gravel substrate provided an excellent habitat for the Chloroperlidae (Hynes 1976). More than 80% of all the adult stoneflies belonged to this family.

Most Plecoptera have been reported to emerge at night or during very early morning hours (Hynes 1976). Hartland-Rowe observed chloroperlids in Alberta, Canada emerging from 0430 to 0600 (Radford and Hartland-Rowe 1971). During the present study, a considerable number emerged beginning at about 1200 and continuing into the afternoon. It was during these periods that predation by Empididae was observed.

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